

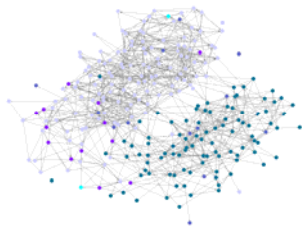
# Overview of Social Network Analysis

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University of California, Irvine

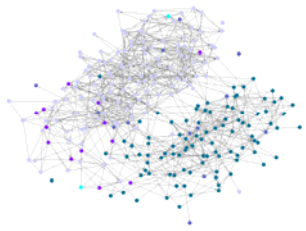
Symposia Series on Systems Science and Health  
Network Analysis: Using Connections and Structures  
to Understand and Change Health Behaviors



# Outline

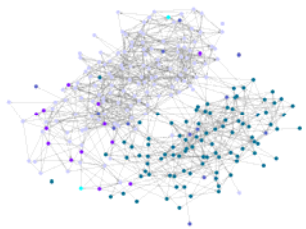
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- Relational data
- Networks and social networks
- Formal representations: Graphs and matrices
- Data considerations
- Social network methods
  - Connectivity
  - Centrality
  - Cohesion
  - Relational patterns and reductions (blockmodels)
  - Subgraphs
  - Structural hypotheses
- Future directions



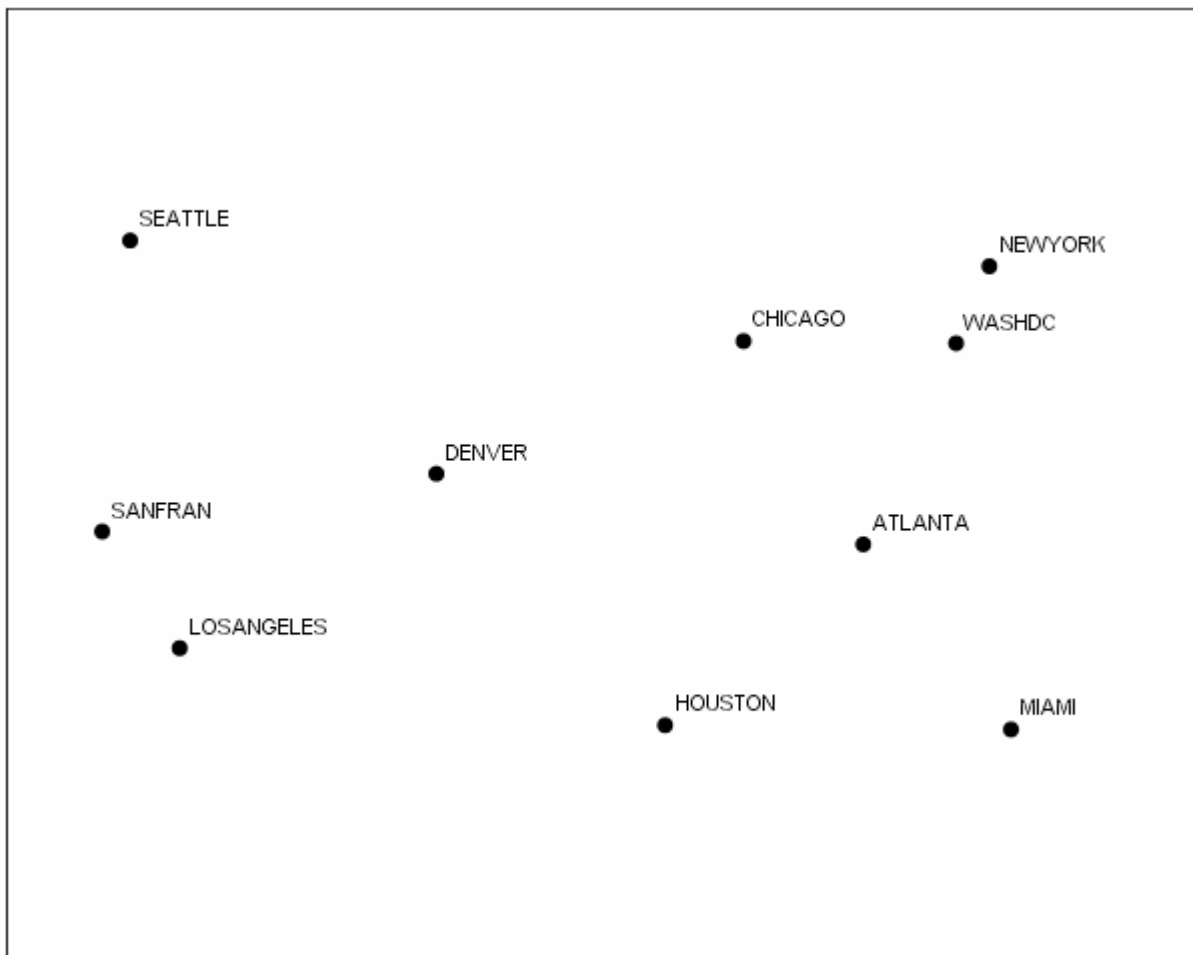
# Relational data

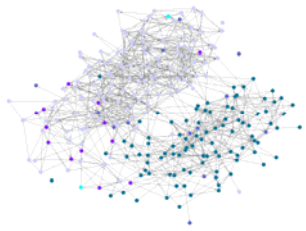
- Property of two or more units, pertaining to
- Relations among units
- Examples:
  - Distance between locations
  - Correlation between variables
  - Similarity between objects
  - Interactions among individuals
  - Transmission of disease between people
  - Diffusion of innovation between organizations



# Example of relational data

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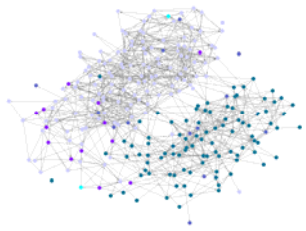




# Example of relational data

## Airline distances between US cities

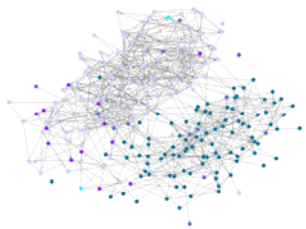
	ATLANTA	CHICAGO	DENVER	HOUSTON	LA	MIAMI	NY	SF	SEATTLE	DC
ATLANTA		587	1212	701	1936	604	748	2139	2182	543
CHICAGO	587		920	940	1745	1188	713	1858	1737	597
DENVER	1212	920		879	831	1726	1631	949	1021	1494
HOUSTON	701	940	879		1374	968	1420	1645	1891	1220
LA	1936	1745	831	1374		2339	2451	347	959	2300
MIAMI	604	1188	1726	968	2339		1092	2594	2734	923
NY	748	713	1631	1420	2451	1092		2571	2408	205
SF	2139	1858	949	1645	347	2594	2571		678	2442
SEATTLE	2182	1737	1021	1891	959	2734	2408	678		2329
DC	543	597	1494	1220	2300	923	205	2442	2329	



# Networks are relational data

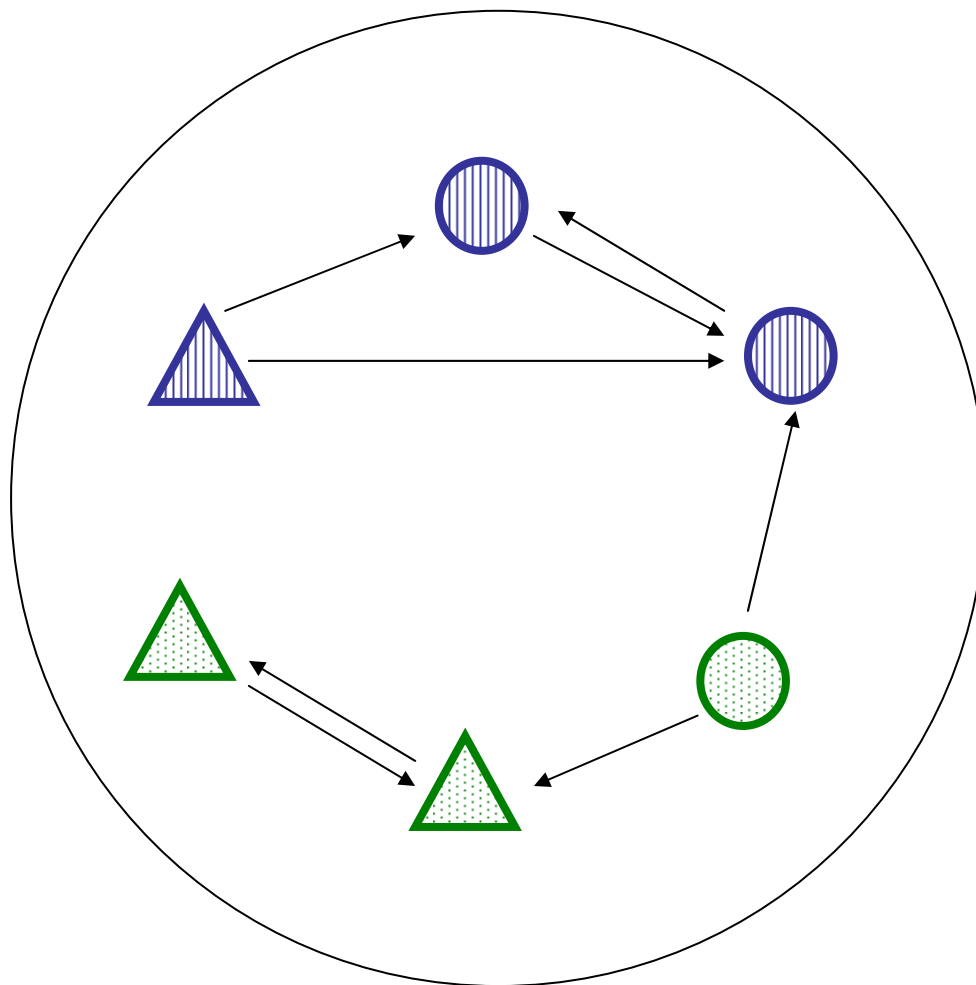
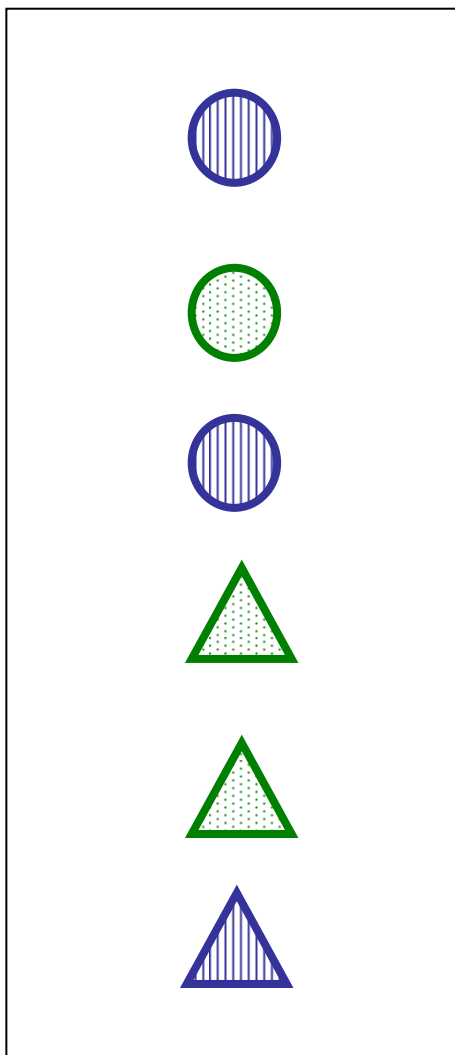
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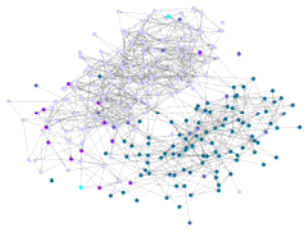
- Set(s) of units
- Linked by one or more relations
- Not just attributes of objects



Units

A network  
units and a relation



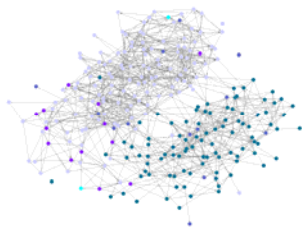


# Networks in general

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- Examples:
  - Flows of information, disease, materials ...
  - Communications
  - Semantic relations
  - Scientific collaboration
  - Citations
  - Neural network
  - Power grid
  - Links between internet URLs
  - ...





# Images of networks

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[Mark Newman's gallery of images](http://www-personal.umich.edu/~mejn/networks/)

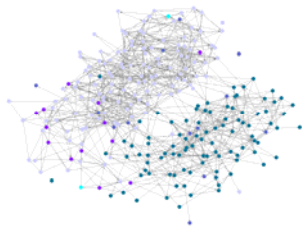
<http://www-personal.umich.edu/~mejn/networks/>

[Nature 2006 scientific journal articles citation image](#)

K. BOYACK, D. KLAVANS, W. B. PALEY (DATA: THOMPSON ISI, COMMISSIONED: K BORNER)

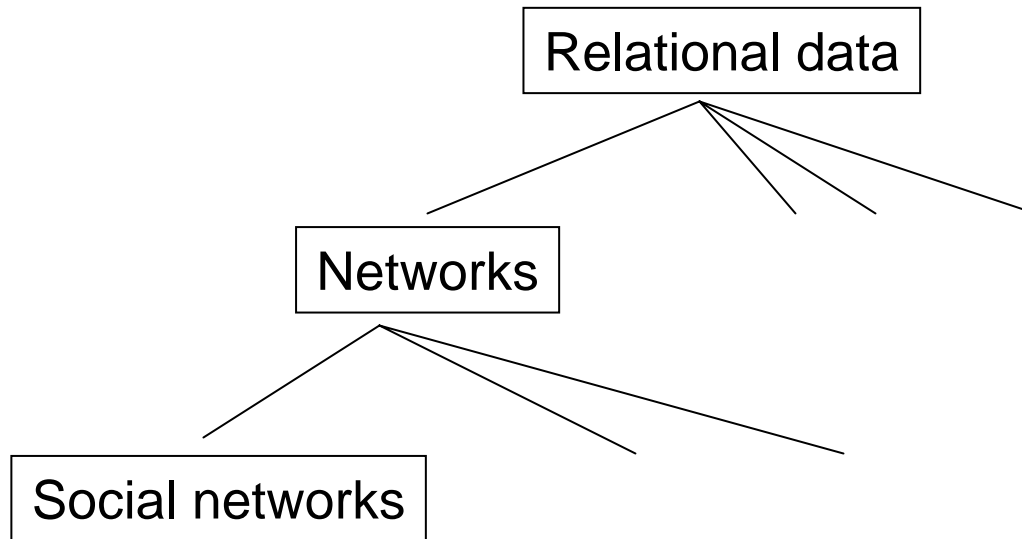
[Protein interaction network](#)

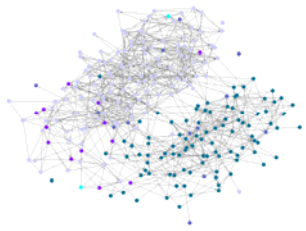
Maslov 2002 issue of *Science*



# Kinds of relational data

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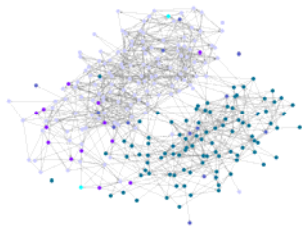




# Social networks

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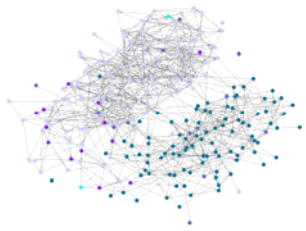
- Relational data on social systems
  - Between humans (or other organisms)
  - Products of human activities
- Elements:
  - Set of social actors
  - Ties between or among them



# Kinds of actors

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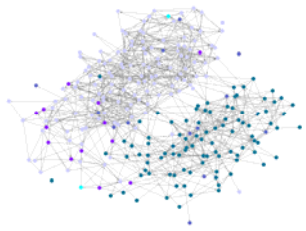
- Individuals
- Collectivities or aggregates
  - Household
  - Organization
  - Country



# Kinds of social relations

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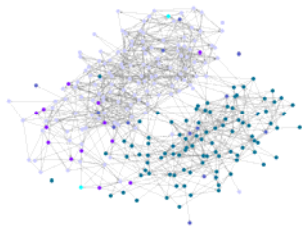
- Interaction
- Affective evaluations – love, hate, respect...
- Resource transfers
- Movement
- Formal relationships
- Kinship
- Joint participation or membership
- ....



# Social network assumptions

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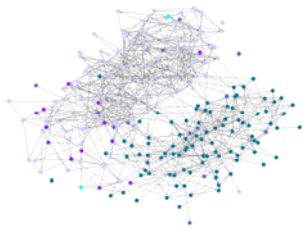
- Relational
  - Linkage, connection, interaction, association, affiliation, membership ...
- Social units are interdependent
- Network structure enables and constrains action
- System-level relational properties are important



# Why network methods?

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- Cannot simply use existing statistical methods
  - Units are not independent
- Want to explicitly model interdependencies
- Network formulation of social constructs

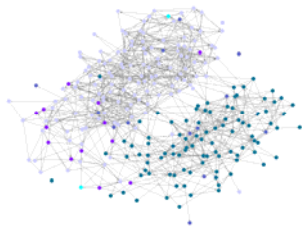


# History of social network analysis

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- Interdisciplinary
  - Graph theory
  - Social psychology
    - Sociometry
    - Group problem solving
    - Group processes
  - Social anthropology
    - Kinship systems
    - Social structure and organization
  - Sociology
    - Organizations
    - Inequality

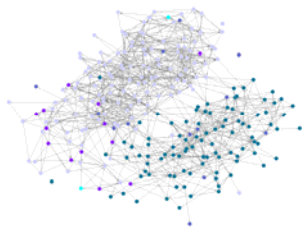




# Formal representations data structures

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- Graph
  - Nodes (vertices, points)
  - Edges (arcs, ties, lines)
- Sociogram
  - Graphic representation
- Sociomatrix
  - Who-to-whom matrix

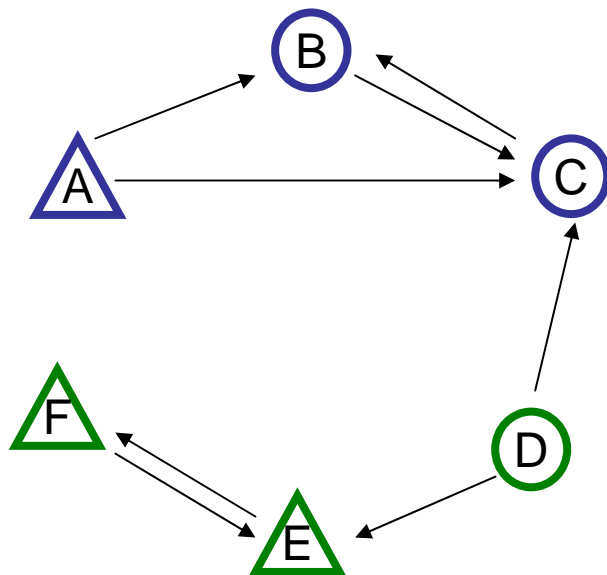


# Graph, sociogram, sociomatrix

Graph arcs

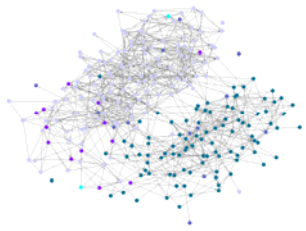
(AB)  
(AC)  
(BC)  
(CB)  
(DC)  
(DE)  
(EF)  
(FE)

Sociogram



Sociomatrix

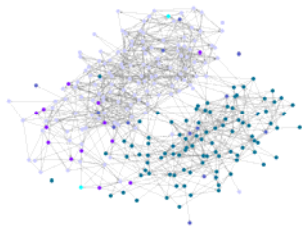
	A	B	C	D	E	F
A	-	1	1	0	0	0
B	0	-	1	0	0	0
C	0	1	-	0	0	0
D	0	0	1	-	1	0
E	0	0	0	0	-	1
F	0	0	0	0	1	-



# Data considerations

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- Complete network vs. ego-centered network
- Directional or non-directional ties
- Dichotomous or valued ties
- Multiple relations or time points
- Actor attributes
- One set of actors or more



# Complete vs. ego-centered

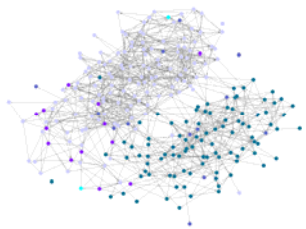
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Complete, social,  
saturated, or census

- A community, population, or group
- Measure ties among all members of the community

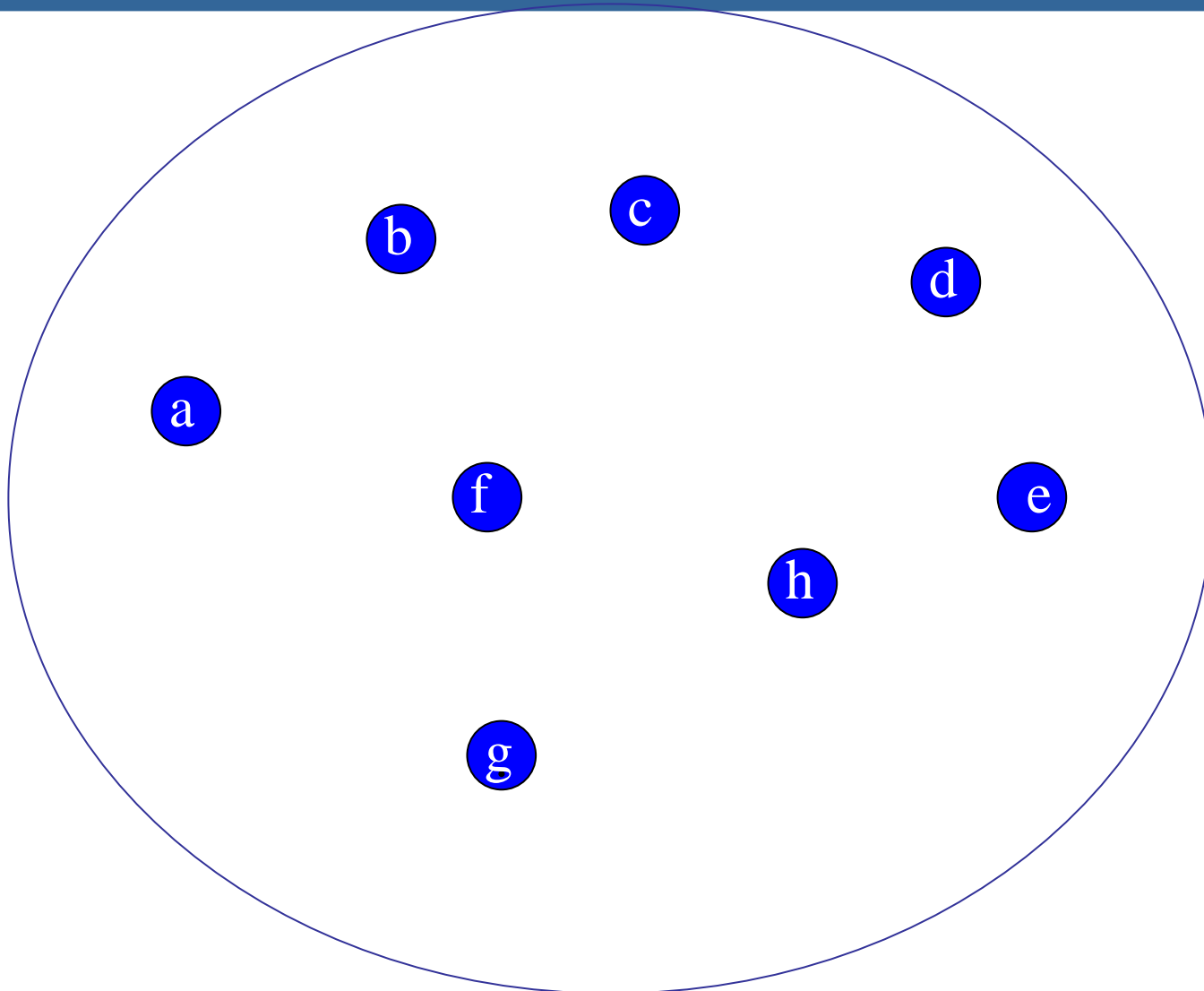
Ego-centered, or  
personal

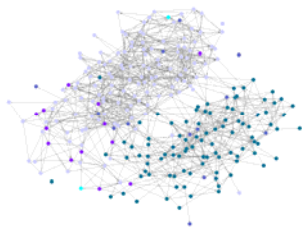
- Sample individuals
- Measure local social environments



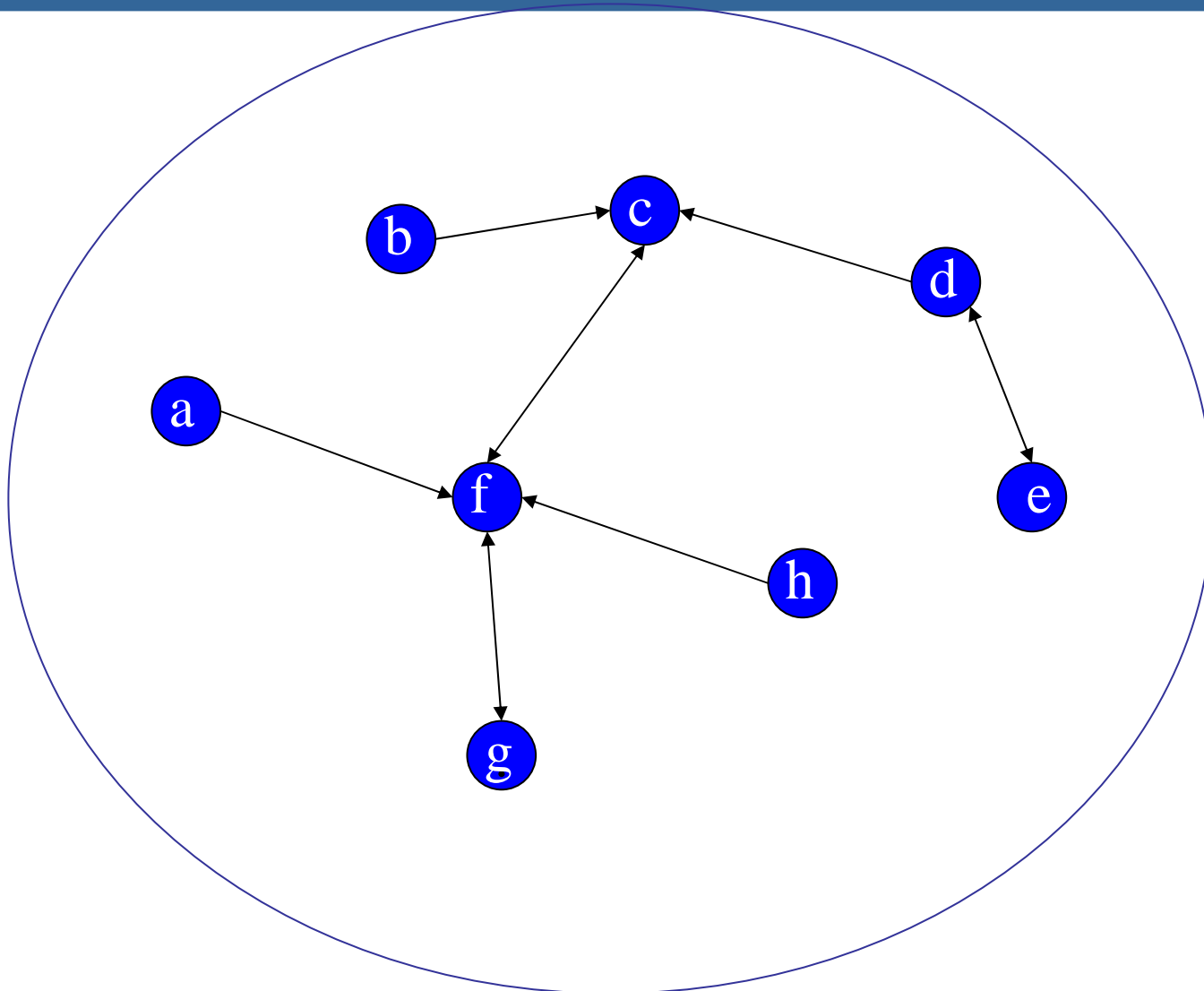
# Population of actors

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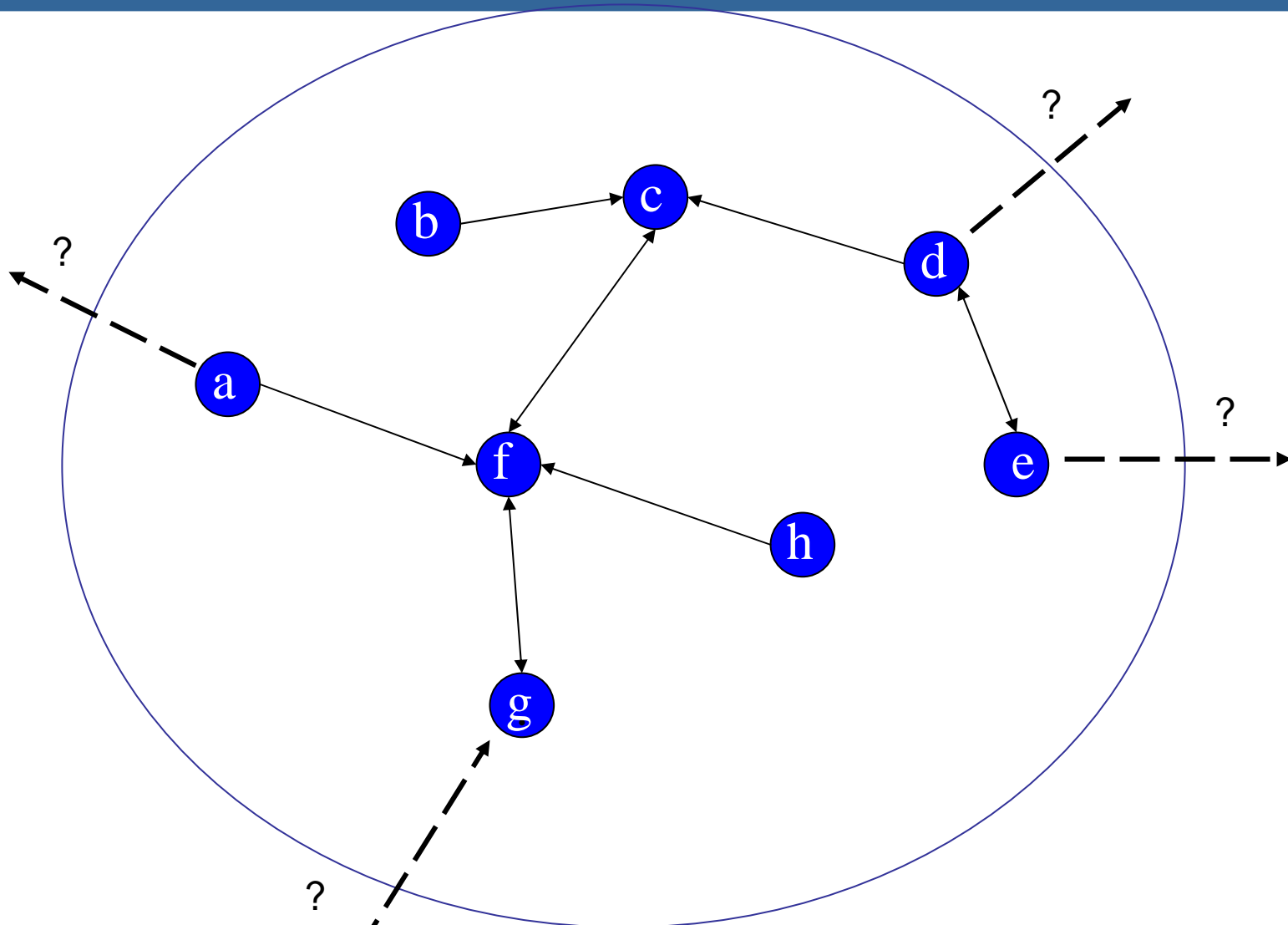


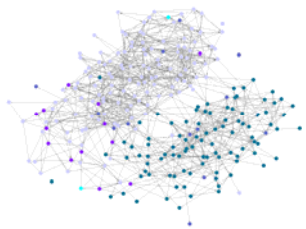
# Ties between all actors





# Unknown ties with outside



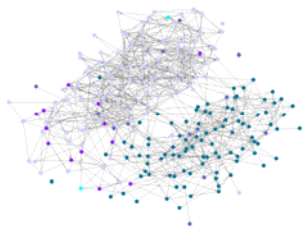


# Sample respondent “egos”

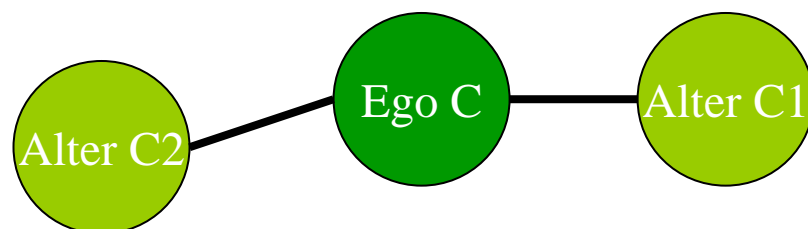
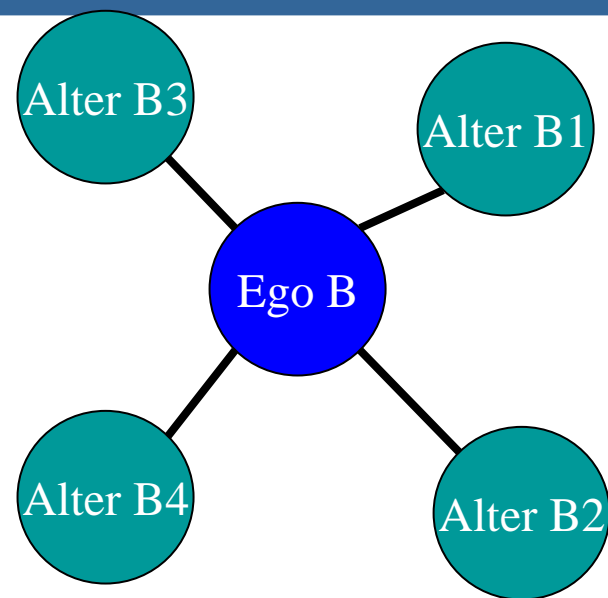
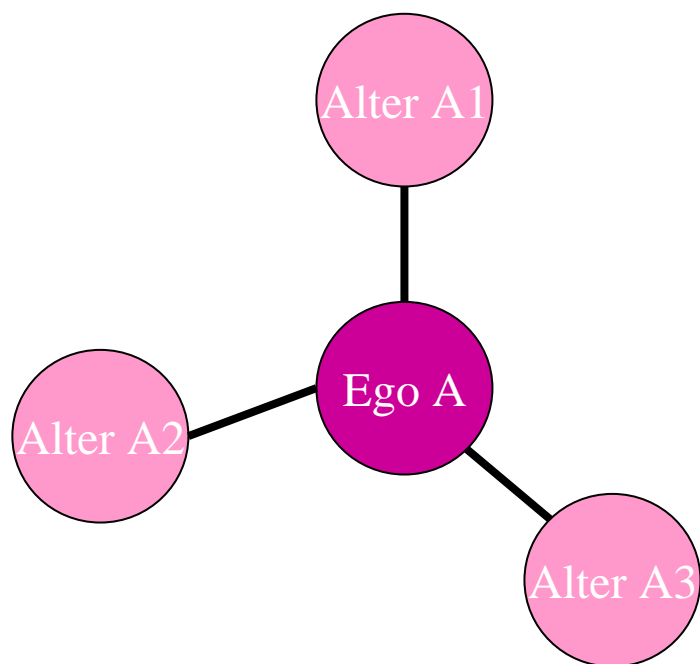
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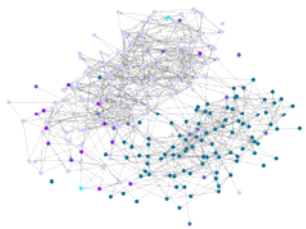




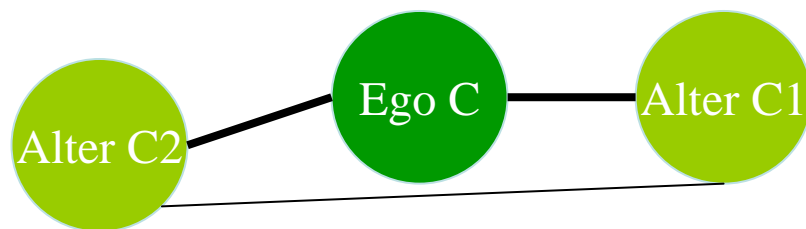
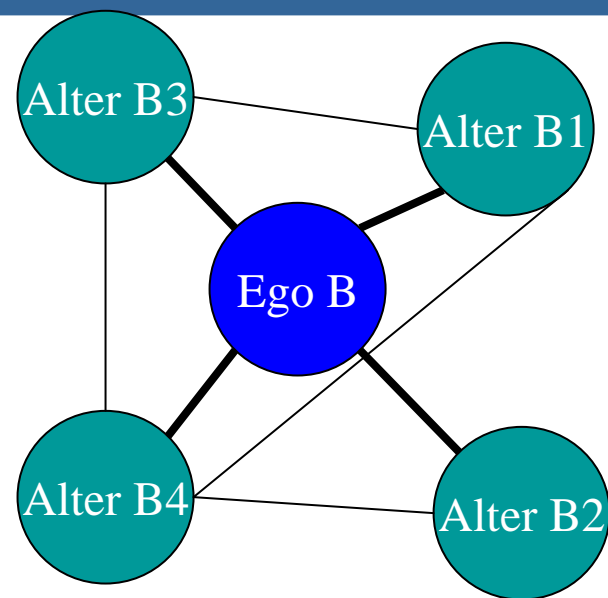
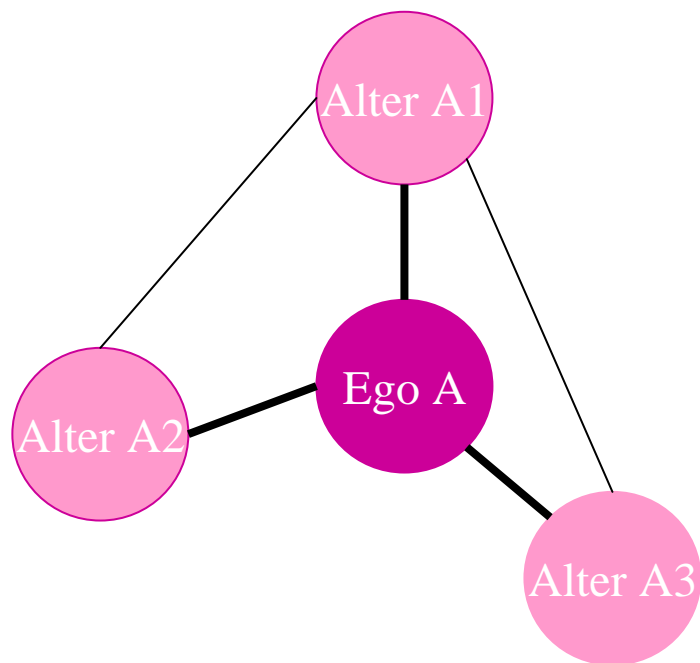


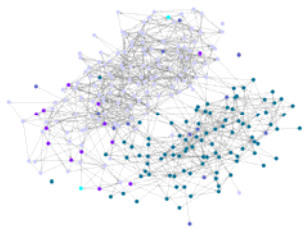
# Elicit lists of “alters”



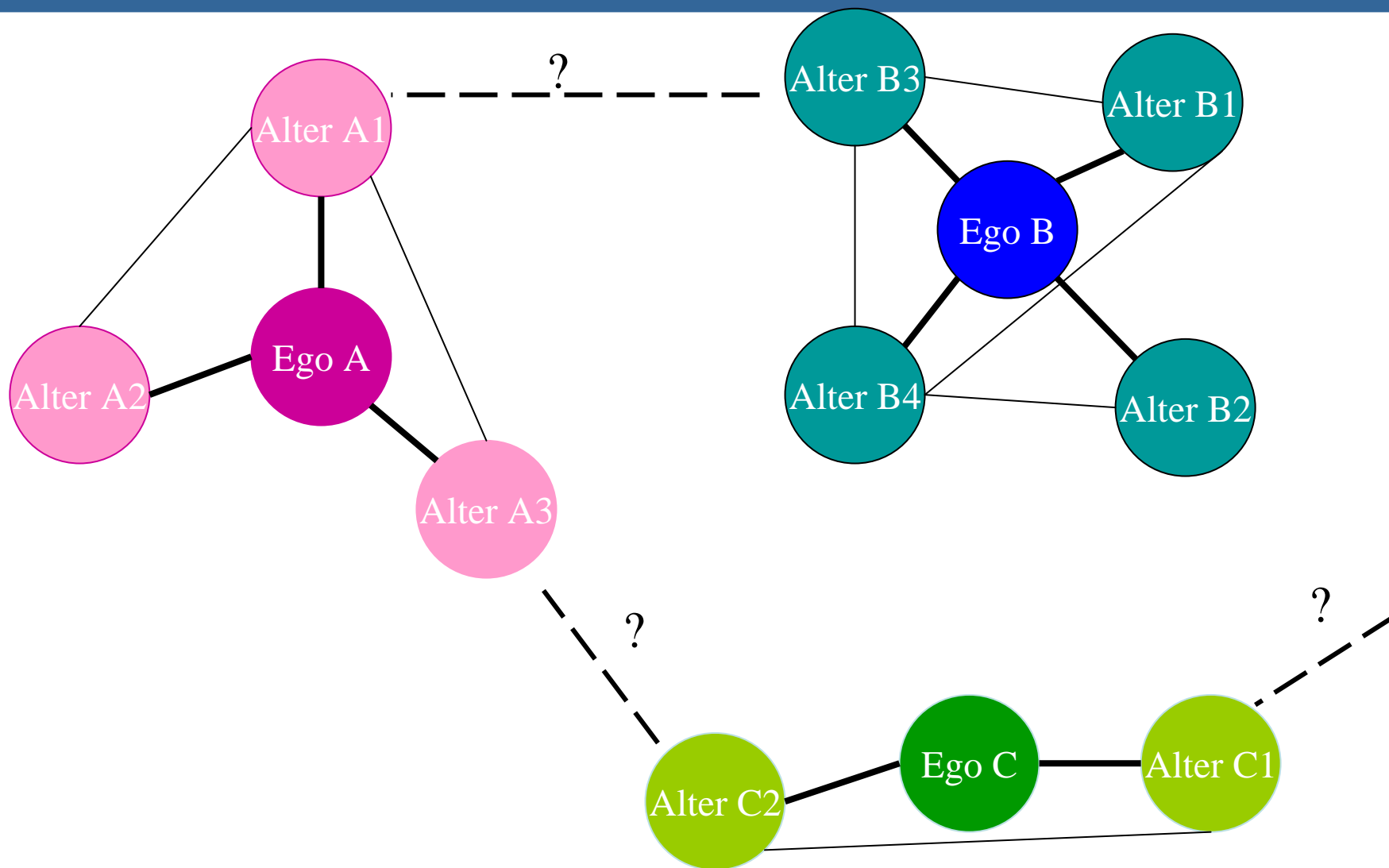


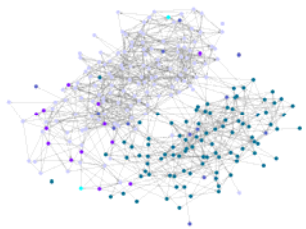
# Ties between “alters”





# Unknown ties

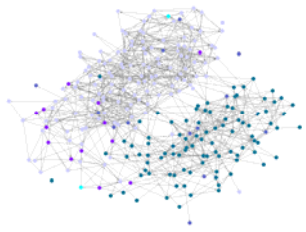




# Ego centered networks vs. complete

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- Network sampling
- Estimate local properties of networks
- But system level structures are not observed
- Other sampling schemes:
  - Link tracing, snowball sampling



# Directional relation

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Directional ties

Origin and destination

Send money

Pass on information

Express affection for

...

